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News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 101, Room E215, Gaithersburg, MD 20899-2500; telephone: (301) 975-3577.

NIST X-RAY DETECTOR HEADS FOR COMMERCIALIZATION

NIST has granted co-exclusive licenses to two private companies for commercialization of a revolutionary microcalorimeter-based x-ray detector with an energy resolution of 2 eV, some 50 times better than conventional semiconductor-based detectors. The new technology will be used in instruments for the characterization and analysis of materials by x rays in semiconductor and other materials-intensive industries.

The detector fits easily onto a commercially available scanning electron microscope and conveniently operates even though the sensor is cooled to near absolute zero. The vastly improved detector system will enable chemical analysis of particles that are difficult or impossible to study with current detectors. It permits the chemical analysis of tiny particles that contaminate silicon wafers during semiconductor fabrication. It also has been used to measure the shift in x-ray energy that occurs due to chemical bonding of one atom to another.

In the meantime, the NIST research team that developed the technology is exploring other uses for it. One current project is evaluating the microcalorimeter's role as the detector on a high-resolution mass spectrometer that might help speed up human gene sequencing.

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PATENT ISSUED FOR CHROMATOGRAPHIC STORAGE DEVICES

A patent has been issued to a NIST research chemist for devices and techniques to dispense small quantities of fluids into a syringe for use as a chromatographic standard, and for techniques for "spiking" chromatographic samples with methane as a reference.

In the first device, a capped permeation tube is placed inside an automatic sampler vial. The liquid sample is located in the vial but outside of the tube; fluid permeates the tube and a vapor forms inside. The syringe needle of the gas chromatographic automatic sampler pierces the septum of the vial and withdraws a controllable mass of fluid from inside the tube. Using this approach, valuable analytical standards can be stored for long periods while permitting very small quantities to be removed whenever needed for the gas chromatograph. The device has a service life of at least five years.

The second device also utilizes an automatic sampler vial. The liquid sample to be spiked with methane is located inside the permeation tube. Outside the tube is a high-capacity absorbent material. This adsorbent is charged with methane, which then permeates into the liquid space at a controllable rate. This device provides a convenient reference for retention index determination and for marking the beginning of the analysis. It is a significant improvement over current methodology in which methane is manually loaded into a syringe.

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RCSB ASSUMES FULL RESPONSIBILITY FOR PROTEIN DATA BANK

On July 1, 1999, responsibility for the Protein Data Bank (PDB) formally shifted from Brookhaven National Laboratory to the Research Collaboratory for

Structural Bioinformatics (RCSB), 3 months ahead of schedule. The RCSB is a joint collaboration between NIST and three universities. The PDB can be accessed on the World Wide Web at nist.rcsb.org/index.html.

The nonprofit international archive for bio-molecular structures used in pharmaceutical and medical research, PDB has provided substantial improvements in service during the past few months. Since the RCSB began assuming responsibility for the PDB, data deposited by users have been turned around in record time, and new tools now provide a broader range of search and reporting options. The success of these developments has accelerated the transition timetable.

The RCSB's PDB gives researchers access to more information about biological structures from a single source than ever before. Via the Web, database users in academia, government, and industry access archival services and formulate complex queries that will provide reliable answers to further their research efforts.

The three-dimensional structures of proteins and other biological macromolecules contained in the PDB hold significant promise for the pharmaceutical and biotechnology industries in the search for new drugs with few or no side effects and the effort to understand the mystery of human disease.

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MICROSTRIP TESTING ACCURATELY MEASURES INTERCONNECT PERFORMANCE

As transistors get smaller and faster, interconnect performance also must be improved. To meet this challenge, manufacturers are combining low-dielectric constant (known as low-K) thin films with high-conductivity copper interconnects. The speed of light in these low-K thin films approaches that in a vacuum while the copper significantly reduces loss. Until recently, it has been difficult to accurately characterize the performance of these systems.

A collaborative effort between NIST and semiconductor consortium (SEMATECH) has developed microstrip test structures that thoroughly assess the dielectric properties of candidate low-K thin films and the conductivities of accompanying metals over a range of 50 MHz to 40 GHz. The test structures are small printed interconnects comprised of the thin film and metal combinations to be characterized.

Testing already has been completed on a new low-K dielectric and copper conductor system supplied by SEMATECH. Other systems from companies such as Dow Chemical and Texas Instruments are undergoing performance assessments at NIST's Boulder, CO, laboratories.

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SMART SOLAR ENERGY SYSTEM HEADED FOR THE PUBLIC

A novel system that uses the power of the sun to directly heat water is about to become commercially available after years of development and testing at NIST.

An exclusive license has been granted to a private company to use the NIST patented technology. The solar water heating system is the first to use photovoltaic cells and computer chips to harness and direct the sun's energy. Photovoltaic (PV) cells convert energy from sunlight into electricity. The NIST system uses an array of these cells to transfer solar power to specially designed heating elements inside a hot water tank.

The system can use as many as six heating elements. A microprocessor monitors the energy produced by the photovoltaic cells, and then determines which heating element or combination of elements to use in the tank. This process enables the system to work very efficiently, taking advantage of the varying amounts of solar energy harvested throughout the day and optimizing the output from the solar cells.

The system eliminates durability and reliability issues associated with previous solar thermal hot water systems. Solar thermal systems heat water by pumping water or an antifreeze solution through solar collector panels. These systems require the use of pipes and circulating pumps to transport the fluid from the storage tank through the solar collectors. The PV solar water heating system does not require a circulating pump or pipes to transport the collected energy to the storage tank; it uses conventional house wiring.

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NEARLY 20K GET O.K. FOR Y2K FROM MEP

Records kept through July 24, 1999, indicate that training for the year 2000 problem provided by NIST through its Manufacturing Extension Partnership (MEP) program has reached thousands of small businesses since its May 1998 debut. More than 19 300 individuals, representing more than 10 200 companies, have participated in 975 workshops nationwide. These statistics represent reports from only 20 states, so the overall numbers of persons and businesses helped are believed to be much higher.

In addition, it is estimated that approximately 20 000 users have downloaded the NIST MEP's Y2K Self-Help Tool since it went online this past February.

Analysts at the Y2K Help Center for Small Business, (800) Y2K-7557 (925-7557), can provide year 2000 advice and assistance in English or Spanish, as well as a free copy of the "Conversion 2000: Y2K Self-Help Tool" software.The tool and other related material can be downloaded from the World Wide Web at y2khelp.nist.gov.

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INCREASED ACCURACY IS GOAL OF NEW PYROELECTRIC RADIOMETER

Researchers at NIST have worked to build and evaluate a practical and convenient pyroelectric radiometer for measuring optical power, radiance, and irradiance in the visible, near, and mid-infrared wavelength regions. Although the development will not provide a new NIST measurement service, it will help NIST upgrade and increase the accuracy of current services. The unique lithium niobate pyroelectric detector incorporates domain engineering (the engineering of specific crystal properties) to orient the polarization in specific detector regions of the crystal to achieve desired noise reduction. The result is a radiometer with high spatial and spectral response uniformity that will make an excellent transfer standard. The radiometer is capable of routine measurements having relative uncertainties approaching 0.1 %.

A paper describing the new detector is available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3337; (303) 497-3237; sarabeth@boulder.nist.gov. Ask for paper No. 30-99.

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WANTED: BALDRIGE AWARD EXAMINERS FOR 2000

It's a tough, demanding job—without pay. So why is a position on the board of examiners for the Malcolm Baldrige National Quality Award so desirable? Here's what one individual, a vice president of a brokerage company, and a senior examiner for 4 years, says: "My experience as a Baldrige examiner has been a tremendous asset to my professional development, has exposed me to an infinite and broad set of networking opportunities, and has enabled me to contribute to a program dedicated to improving organizational performance across the country."

NIST is looking for volunteers from a wide variety of business and not-for-profit organizations to serve a 1 year term on the board of examiners for the 2000 Malcolm Baldrige National Quality Award.

Examiners evaluate applications for the award, prepare feedback reports to applicants citing strengths and opportunities for improvement, and recommend award winners to the NIST director. Qualifications include expertise in business, education or health care management processes and results, as well as knowledge of practices and improvement strategies that lead to organizational excellence. The board consists of about 400 members, including nine judges and about 60 senior examiners. Applications for the board will be available in November 1999.

Additional information is available by calling (301) 975-2036 or on the Baldrige award web site at www.quality.nist.gov/examr2000/page1-top.htm.

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NIST ADVANCES SMART CARD SECURITY INITIATIVE

The National Information Assurance Partnership (NIAP) is a joint NIST-National Security Agency activity to develop and oversee independent laboratory capability to perform security evaluations of computer-related products against the recently approved ISO International Standard 15408 (the Common Criteria). NIAP initiated work with the smart card financial user community to develop 15408-based security criteria for smart cards in the form of one or more Protection Profiles (PPs). Although some smart card PPs already exist, they were developed from the perspective of the circuit chip or card manufacturers, not the card issuers or end-users. Those efforts do not reflect the full security requirements for smart cards when deployed in financial payment systems or other end-user applications.

Under NIAP sponsorship, the major international credit card companies recently formed the Smart Card Security Users Group for the purpose of developing mutually acceptable PPs, laboratory accreditation criteria covering unique smart card testing requirements, along with the needed specific tests and methods. A NIST staff member leads the NIAP smart card initiative and serves as first chairman of the new group.

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SIMNET USED TO COMPLETE THE SIM INTERNATIONAL COMPARISON OF ELECTRICAL UNITS

With observers from Argentina, Canada, Costa Rica, Jamaica, Mexico, and Uruguay, the last NIST measurements were performed on traveling digital multimeters (DMMs) that have been circulated among the Interamerican Metrology System (SIM) regions of ANDIMET, CARIMET, and SURAMET. The recently inaugurated metrology network, SIMnet, was used to share test setup information (including high-resolution photos, full-motion video, and data) with participants in the SIM International Comparison of Electrical Units.

Observers watched as the DMMs were connected to the NIST artifact-calibrated multifunction calibrator by NIST researchers. Then the participants witnessed the data collection on a shared LabVIEW test panel. Special connections and setups were photographed and pasted in the electronic notebooks for each session. At the end of the test, a spreadsheet data file was sent to the appropriate pivot laboratory in each of the metrology regions. The date and time of the test had been posted on the SIMnet-DMM web site several weeks before the tests. Detailed test procedures and a list of test points also were available at this site.

Network bandwidth is still a major limitation in most SIM countries; however, the situation is improving rapidly. With the addition of a faster Internet connection in Mexico, it is now possible to carry on reasonably good bidirectional meetings between the national metrology institutes in NORAMET.

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NIST ASSISTS IN DEVELOPING CALIBRATION PROCEDURE FOR LIDAR MEASUREMENT SYSTEM

In conjunction with a continuing effort to assist emerging technologies, NIST calibrated a 3 m long scale bar for a private company. This bar consists of 24 precision tooling balls mounted equally spaced on a carbon fiber box section base. It was measured on a coordinate measuring machine that has only 1 m capacity. Since the length of the bar exceeded the machines travel, it was necessary to measure it in four separate setups and carefully combine the results. The uncertainty of the results was less than 9 μm. This scale bar will be used to verify the calibration of the private company's three-dimensional lidar coordinate system.

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NIST MEASUREMENTS SETTLE QUESTION FOR WELD INSPECTORS

NIST in cooperation with ASTM, determined the extent of variation in the ultrasonic properties of 18 calibration blocks of the type specified in ASTM Standard E164. The blocks, known as International Institute of Welding (IIW) type calibration blocks, are a common ultrasonic reference block used internationally by weld inspectors to calibrate their inspection instrumentation. Numerous standards-writing organizations are concerned that the lack of material specifications for these blocks may create excessive variation in their ultrasonic properties, leading to conflicting inspection results in the field and costing companies both here and abroad millions of dollars in wasted labor and product. In response to these concerns, NIST performed a series of measurements on the blocks to ascertain the severity of the problem. NIST results indicate that the variation was not large enough to cause calibration problems involving weld inspection equipment.

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ONE IN A MILLION

In June 1997, President Clinton announced the Million Solar Roofs Initiative. The goal of this program is to install 1 million solar energy systems (photovoltaic and thermal) on buildings across the United States by the year 2010. A registry has been established to permit the Deapartment of Energy both to track solar system installations across the country and to acknowledge system owners for their contribution to the goals of the Million Solar Roofs Initiative. In May 1999, NIST was registered as one of the contributors to the Million Solar Roofs. NIST's Kadena Air Force Base project was the first overseas military installation and one of the first 100 sites to be registered.

This joint U.S. Air Force/NIST effort installed two photovoltaic solar water heaters, using NIST patented technology, on two military housing units in Okinawa, Japan. The sites are providing experimental "on-the-job" field data to NIST researchers seeking to improve computer simulation models. The site in Okinawa was selected by the Air Force due to the high costs of electrical energy. The civil engineering information on this project can be found at http://www.bfrl.nist.gov/863/pvsolar/kadena.html.

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COMMON CRITERIA BECOMES ISO INTERNATIONAL STANDARD 15408

NIST has been engaged in a cooperative project with the National Security Agency and the governments of Canada, France, Germany, Netherlands, and the United Kingdom to develop the Common Criteria (CC) for Information Technology Security. The CC provides the structure and components to describe standardized security requirements for all types of computer-related products. These requirements can be used as the basis for performing security testing and evaluation of such products. The CC Project also has worked very closely and inter-actively for the last 5 years with the International Standards Organization (ISO) to help the CC become a three-part International Standard. That work came to fruition in June 1999 when the ISO National Bodies balloted to accept the CC as International Standard 15408, an event that has been awaited by numerous nations and computer product manufacturers throughout the world. The CC already has been translated into French, German, Russian, Japanese, and Korean, and other translations are in progress. A NIST staff member, who was one of the organizers of the CC Project and an author of the CC, is ISO Project Editor of Part 1 of the new standard.

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NIST DEVELOPS NEW FIRE SMOKE METER

Smoke from burning materials can alert people to a fire (by triggering a detector), increase the rate of flame spread, and impede escape. Thus, its measurement is critical both to fire hazard assessment and to the acceptability of products for sale. NIST scientists have produced a new device for quantifying the yield of smoke in both bench-scale and room-scale tests. Development of the device was enabled by a prior finding that a key optical property of smoke, its specific extinction coefficient, is nominally independent of the burning material. The new smoke meter measures the obscuration of a laser beam and converts this to the mass generation rate of smoke and thus the smoke yield. The apparatus is fabricated almost entirely of commercially available components and dramatically reduces the labor needed to obtain this information. The results are in good agreement with the traditional, but tedious, mass collection technique. A detailed analysis shows that the expanded uncertainty in the measurements is about 20 %. A manuscript has been submitted to *Fire and Materials.*

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FIRST ATOMIC FORCE MICROSCOPE (AFM) IMAGE OF ATOMIC STEPS ON SILICON PRODUCED DIRECTLY BY DIODE LASER INTERFEROMETER

NIST researchers have used the Fabry-Perot interferometer/ microscope stage developed under the Diode Lasers for Length Measurement Project for the first time to produce a direct image of single atom step terraces on a <111> Si surface. Working in air, with a commercial AFM interfaced to the diode laser system, the team used a time-interval analyzer (technology borrowed from the M3 project) to produce images of the silicon step-height artifact. Further work will result in even better images, as the bugs are ironed out of the system. The interferometer is capable of directly producing subnanometer measurements using a traceable primary standard of length: laser frequency.

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NIST PROCESS SPECIFICATION LANGUAGE WORK BEGINS THE ROAD TO STANDARDIZATION

At an International Standards Organization (ISO), Technical Committee (TC) 184, Subcommittee (SC) 4 standards meeting in Lillehammer, Norway, a resolution proposing the Process Specification Language (PSL) work as a Preliminary Work Item (PWI) was approved. Ten countries voted "yes" to the resolution, and three countries abstained (Sweden, Australia, and Germany).

The PWI is the first stage of the standardization process, in which countries interested in the work come together to further pursue the work. During the PWI phase, there are no time constraints, thus allowing the participants to take as much time as is needed to ensure that the work is valuable and complete. When a level of consensus is reached, the work will be proposed as a New Work Item (NWI), which represents the next phase of the standardization process.

The vision for the standardization of PSL is that it will be a joint project between SC4 and SC5, which are both subcommittees in Technical Committee (TC) 184 within ISO. A resolution was passed at the SC5 meeting in late April to further explore and possibly pursue standardization of PSL. This was spawned from the interest of almost all of SC5s Working Groups in exploring the use of PSL in their technical work. TC184 focuses on industrial automation systems and integration, while SC4 specifically focuses on standardization of information shared or exchanged in the area of

industrial and manufacturing applications and SC5 focuses on standards relating to enterprise modeling.

The goal of the PSL work is to develop a neutral representation of manufacturing process information, based upon formal theories and principles, to enable the integration of manufacturing process-related applications.

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NEUTRON PROBES PROVIDE VALUABLE INSIGHT INTO DIFFUSION OF POLYMERS THROUGH MEMBRANES

Understanding the interdiffusion of polymer chains at interfaces is crucial to many applications such as coatings, adhesion, composite lamination, and fracture strength development. Neutron reflectometry, as carried out at NIST, has proven to be an extraordinarily powerful technique for studying polymer interdiffusion at polymer-polymer interfaces. A high degree of sensitivity to structural details is achieved by selective hydrogenation or deuteration of the polymer constituents.

Recently, NIST scientists have teamed up with NCNR staff to study what effect the introduction of ultrathin barrier membrane structures (about 6 nm) has on the dynamics of polymer interdiffusion. Barrier membranes play important roles in biology and metallurgy as well. In the present experiment, a barrier was created from a cross-linked polymer, which makes it insoluble in surrounding polymer material yet allows transport of the surrounding material across it.

By measuring the neutron reflectivity from this polymer-membrane-polymer sandwich at different stages of thermal annealing, time-dependent chemical composition depth profiles with nanometer resolution can be obtained. One of the important findings of this research has been that the membrane barrier remains intact yet is relatively mobile during the diffusion process. Besides providing valuable insight into the transport properties of ultrathin polymer membranes, this project serves as a model for designing future reflectivity experiments to probe the permeability of biological membrane systems.

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NIST SCIENTISTS IDENTIFY NOVEL ORDERING PROCESSES IN GLASS FORMATION USING SIMULATION

As reported in the May 20 issue of *Nature* and the June 21 issue of *Physical Review Letters,* NIST scientists have identified a growing length scale associated with the approach to the glass transition in liquids on cooling. When liquids are cooled to form glasses (amorphous solids), they become increasingly viscous and eventually "freeze" without crystallizing. It long has been suggested that the "slowing down" of liquids before they vitrify is related to an increasing length scale in the liquid, but neutron scattering measurements of density fluctuations have been unable to detect any evidence of a growing correlation length such as that usually associated with the approach to a conventional critical point (like the familiar gas-liquid critical point in a fluid.) But using molecular dynamics computer simulations and focusing on the atomic motions in both simple and polymeric glass-forming liquids, the scientists showed the tendency for increased correlation between the displacements of atoms. The length scale of this correlated motion (which measures the distance over which atoms move—or don't move—together) grows with decreasing temperature and may diverge at low temperature. Related to this length scale is a dynamical variable that behaves like the static order parameter that characterizes conventional critical phenomena. By identifying this new dynamical measure of order in glass-forming liquids, the researchers established a possible link between the glass transition and the critical phenomena familiar from equilibrium statistical physics.

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FORMAL TESTING OF AUTOLOADING PISTOLS FOR POLICE OFFICERS TO BEGIN

The National Institute of Justice (NIJ) will begin testing various new models of autoloading pistols in accordance with NIJ Standard—0112.03 Autoloading Pistols for Police Officers, dated November 1998. The standard was revised and updated extensively by staff at NIST, who also participated in the selection and certification of laboratories to perform the testing. Under the performance testing of the standard, each pistol is carefully inspected for defects, flaws, and deficiencies and then is submitted to a rigorous firing test to assure reliability and safety. Currently, 22 models of autoloading pistol have been submitted by several manufacturers for testing under this program. The purpose of the NIJ Standards program is to assist law enforcement and corrections agencies in the acquisition of the highest quality equipment possible.

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NIST/BIPM COMPARISON MADE OF 10 V REFERENCE STANDARDS

A comparison of 10 V voltage reference standards was carried out between the Bureau International des Poids et Mesures (BIPM) and NIST from October 1998 to January 1999. The NIST participation occured at both the Gaithersburg and Boulder sites. The primary purpose of this comparison was to provide a solid link between comparisons of Josephson voltage standards (JVS) via Zener reference standards currently and independently ongoing both in North America and in Europe. Two additional goals of this BIPM-NIST comparison were (1) to test the techniques used in the JVS comparisons, in particular, the veracity of the corrections applied to the traveling Zener standards due to variations in atmospheric pressure and (2) to test the stability of the traveling standards when shipped overseas as freight.

Three BIPM 732B Zener reference standards were used as the travelling standards. The three measurements agreed within their combined relative uncertainties of about 5×10^{-8}. This provides a solid link between the ongoing EUROMET and NORAMET intercomparisons.

The agreement is influenced significantly by the sensitivity of Zener standards to changes in atmospheric pressure. For example, the 1600 m elevation difference between Gaithersburg and Boulder causes the Zener output to shift as much as 3.9 μV. Normal weather changes are similarly important. This shift due to pressure fluctuations is much larger that the noise exhibited by typical Zener standards and can have a severe detrimental impact on measurement results. Hence, it is very important that the corrections applied to account for pressure variations be fully characterized and understood. The proper means to account for pressure changes in the context of interlaboratory comparisons is the subject of ongoing discussion. For this comparison, the pressure coefficients of the reference standards were measured by BIPM and verified by NIST in Gaithersburg. The measured values, along with pressure determinations at the time of measurement, were used to correct the measured values for the data analysis. The good agreement among these three laboratories demonstrates the efficacy of this procedure and provides confidence that a similar procedure can be applied to other interlaboratory comparisons in which Josephson voltage standards are compared via traveling Zener references. It also shows that the commercial shipment overseas of these reference standards was acceptable.

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PATENT ALLOWED FOR EUV AND X-RAY LITHOGRAPHY MASK INSPECTION

A major problem for both leading candidates for next-generation lithography, extreme ultraviolet (EUV) and x-ray lithography, is the inspection of the intricate masks that pattern microcircuits on the wafer. A NIST scientist and a scientist at the University of Wisconsin have been granted a U.S. patent for the invention of a high-resolution EUV/x-ray camera that provides exact, real-time images of the pattern as it would appear at the wafer plane. The camera works by converting the EUV/x-ray image that is produced on a thin membrane photocathode into a replica image consisting of photoelectrons. The photoelectron image then forms the object for a low-energy, high-resolution electron microscope, which projects a magnified image onto a CCD camera. The expected spatial resolution of the camera is 20 nm, which is adequate to visualize defects in patterns using 100 nm design rules, a goal for the first decade of the 21st century. Additional information can be found at http://physics.nist.gov/ppg and http://www.xraylith.wisc.edu/

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FIRST CALIBRATION CUSTOMER ARRIVES AT SURF III

The first user of the NASA-supported Spectrometer Calibration Facility (BL-2) at NIST's synchrotron, SURF III, arrived in July 1999. Researchers at the University of Colorado are calibrating the EUV Grating Spectrograph, part of the Solar EUV Experiment (SEE), using the SURF III electron storage ring as a standard of irradiance. The spectral distribution and intensity of the synchrotron radiation from SURF III can be calculated from well-known accelerator parameters, providing accurate irradiance values for the calibration of instruments in the extreme ultraviolet spectral region. The uncertainty in calibrations utilizing SURF III as a calibration source has been substantially reduced by the recent upgrade in which the entire magnet structure from SURF II was replaced with a carefully designed and manufactured solid steel magnet, which now provides a highly uniform magnetic field.

The SEE instrument is one of several instruments aboard NASAs Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics (TIMED) satellite, the first science mission to be launched as part of the Solar Terrestrial Probe Program. The SEE consists of two extreme ultraviolet (EUV) sensor packages: the

EUV Grating Spectrograph (EGS) and the XUV Photometer System (XPS). The EGS is a normal incidence grating spectrograph with an array detector that will record solar spectra in the 25 nm to 195 nm spectral range with a resolution of about 0.4 nm. The detector is a 64 pixel by 1024 pixel gold-coated microchannel plate with 25 μm wide pixels. The XPS is a set of 12 silicon photodiodes, many with thin-film filters deposited directly on the active area of the photodiode. The filters are selected to limit the response of each photodiode to a 5 nm bandpass in the EUV. A set of five filtered detectors will provide spectral information in the 1 nm to 35 nm spectral range. Additionally, an uncoated silicon photodiode and interference filter will measure the important Lyman-α irradiance at 122 nm. The solar irradiance values measured by SEE will help quantify the energy input of the atmospheric dynamics and chemistry processes that the TIMED mission is designed to investigate. See the following sites for more details: http://www.timed.jhuapl.edu/home.htm and http://lasp.colorado.edu/see/

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NEW VALUES OF THE FUNDAMENTAL PHYSICAL CONSTANTS RECOMMENDED

Accurate values of fundamental constants, such as the elementary charge, the magnetic flux quantum, the molar gas constant, and the Avogadro, Boltzmann, Faraday, and Rydberg constants, are of great importance to the scientific and technological communities because they are used in many practical calculations. At about midnight on July 23, 1999, the new 1998 self-consistent set of some 300 values of the basic constants and conversion factors of physics and chemistry recommended by the Committee on Data for Science and Technology (CODATA) for international use first became available for scientists and technologists worldwide at the web site of NIST's Fundamental Constants Data Center (FCDC), physics.nist.gov/cuu (or directly at physics.nist.gov/constants). The new set is the result of the 1998 CODATA least-squares adjustment of the values of the constants carried out by NIST scientists under the auspices of the CODATA Task Group on Fundamental Constants. Based on all of the data available through Dec. 31, 1998, the new set replaces its immediate predecessor recommended by CODATA in 1986. The new values, like the 1986 values that they replace, are available at the FCDC web site in an easily searchable form as well as in the form of tables.

A paper describing in detail the new CODATA least-squares adjustment will be published in an archival journal by early 2000. This paper summarizes and analyzes the extraordinary amount of experimental and theoretical data that have become available in the last 13 years—data that have led to reductions in the uncertainties of many of the recommended values of the constants by a factor of 5 to 10 or more and, in the case of the Rydberg constant, by over two orders of magnitude.

Because of the modern and highly beneficial trend of having new information immediately and widely available on the web, the CODATA Task Group on Fundamental Constants has decided that 13 years between adjustments is no longer acceptable. In the future, by taking advantage of the high degree of automation incorporated in the 1998 adjustment, CODATA will issue a new set of recommended values at least every 4 years and more frequently if a new result is reported that has a significant impact on the values of the constants.

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SUCCESSFUL CHAMBER DEPLOYMENT TEST COMPLETED OF NIST PORTABLE TRANSFER STANDARD RADIOMETER

The first chamber deployment test of the NIST Thermal-infrared Transfer Radiometer (TXR) was completed successfully in July 1999 at Los Alamos National Laboratory (LANL) in Los Alamos, N.M. The purpose of the TXR is to transfer the NIST scale of infrared radiance from NIST to working standard sources used by the aerospace industry, particularly those involved with calibration of the National Aeronautics and Space Administration's Earth Observing System (EOS). These working standards are usually blackbody sources. They are used in various space-simulating vacuum chambers located throughout the aerospace industry to calibrate space-flight instruments used for Earth remote sensing.

In the deployment test at LANL, the TXR was mounted in a large vacuum chamber in a location where a space-flight instrument had been calibrated previously and the TXR viewed the same blackbody source that the space-flight instrument had viewed through the same set of mirrors. This sort of in situ capability allowed the TXR to determine accurately the radiance levels that were used to calibrate the space-flight instrument. The entire TXR instrument was in vacuum and cooled to near liquid-nitrogen temperatures during the 8 day LANL test. No leaks or other TXR equipment failures occurred, and the TXR was able to acquire useful radiometric data. The TXR has been returned to NIST for calibration maintenance and preparation for future deployments at EOS calibration facilities.

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CALCULATIONS OF GIANT MAGNETORESISTANCE; TESTING THE RELAXATION TIME APPROXIMATION

The commercial magnetic hard disks that have the highest data storage densities are those whose read heads use the giant magnetoresistance (GMR) effect. The development of GMR read-head technology is expected to enable the maximum attainable recording density to be doubled each year for the foreseeable future. GMR also provides the basis for new magnetic sensor technologies. The GMR effect is observed in thin magnetic multilayer structures, in which magnetic and non-magnetic layers alternate. If the magnetic layers are in an antiferromagnetic configuration in the absence of an external magnetic field, they can be aligned by application of such a field. The electrical resistivity of the system decreases in the aligned state, and thus the external magnetic field can be detected by measuring the change in electrical resistance of the structure. The exact mechanism of GMR is still controversial.

NIST research on optimization of the GMR effect involves extensive theoretical and experimental studies. Most extant theoretical work is based on solving the Boltzmann equation that describes electron transport in multilayers. This equation is almost always simplified by invoking a relaxation approximation. The errors associated with this approximation recently have been critically evaluated, for the first time, by NIST researchers who have devised a new method of solution of the Boltzmann equation that does not require the relaxation time approximation. They have compared approximate results with those obtained by their full numerical method, in application to well-characterized model systems. Their results [*Physical Review B* **59**, 13338 (1999)] show that the relaxation time approximation is valid within 10 % for metals with simple electronic structure. The approach is being extended to more complex materials, which are highly anisotropic and which are less likely to be properly described by the relaxation time approximation.

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GROWING USE OF NETWORK SIMULATIONS EXPECTED TO INCREASE THE IMPORTANCE OF ACCEPTED VALIDATION PRACTICES

Deployment of networks will grow increasing complex as industry lashes together a mix of wired and wireless technologies into large-scale heterogeneous network architectures and as the forms and sources of network traffic among mobile users become increasingly difficult to predict. For example, this projected increase in complexity already affects various Department of Defense combat networks. Faced with this growing complexity, network designers and researchers are resorting to simulation more frequently in order to predict the expected performance of complex networks and to understand the behavior exhibited by networking protocols not originally designed to operate in such environments. Industrial network designers also are increasing their use of network simulations. Such growing reliance on simulation raises the stakes with regard to validating the correctness and predictive merits of specific simulation models. Yet no accepted practices and techniques exist to help validate network simulations.

In May 1999, NIST and the Defense Advanced Research Projects Agency co-sponsored a workshop to discuss approaches to validate network simulations. The workshop brought together leading simulation practitioners from many companies as well as researchers from universities. Workshop attendees submitted position papers addressing key issues with regard to simulation validation. Discussions at the workshop revealed many approaches to validation currently pursued by practitioners and researchers. During the workshop, a consensus developed around the following:

- Researchers presenting papers based on simulation studies need to consistently present the approach used to validate their models. Ideally, simulations should be made publicly available concurrent with related papers.
- Simulation users would benefit from standard approaches to document the model underlying a given simulation software module, including a description of how that software has been validated.
- The community needs a better understanding of the levels of validation required in different circumstances. For example, validation against a specific implementation can be mandatory or inappropriate, depending on the question at hand.
- Finally, the set of available validation tools should be improved. Smarter tools to compare traces would be valuable, as would more sophisticated (multi-resolution) statistical techniques. A wider set of multi-simulator test scenarios also could prove helpful.

The web site is http://www.dyncorp-is.com/darpa/meetings/nist99may/index.html.

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U.S. IMS MISSION KICK-OFF TEAM MEETING HELD AT NIST

NIST hosted the kick-off meeting for the U.S. team for the Intelligent Manufacturing Systems (IMS) MISSION Project in June. MISSION is focusing on the development of neutral interfaces for distributed manufacturing simulation. NIST is the lead for Work Package 2 focusing on architecture, data model, and interface specifications. Participants in the meeting included staff from NIST, private companies, and universities.

The meetings topics included a brief history of the IMS/MISSION Project, a review of proposed architecture specification, DOD High Level Architecture overview, data modeling and interface specifications, status reports on the work packages, discussion of Consortium Cooperative Agreement changes, and technical issues on requirements and scope of the MISSION Project. NIST also hosted the Regional Leaders Meeting in July 1999, and hosted the MISSION International meeting in October 1999.

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NIST PROMOTES PRIVACY AND IT SECURITY IN HEALTHCARE

In November 1998, NIAP (a joint initiative of NIST and the National Security Agency) and the Healthcare Open Systems and Trials (HOST—a consortium of approximately 40 healthcare organization members), co-sponsored a workshop to assess the interest of healthcare communities in establishing a forum with the goal of using the Common Criteria for Information Technology Security Evaluation, ISO International Standard 15408. The 56 workshop participants agreed to establish the "Forum on Privacy and Security in Healthcare." A follow-up meeting was held in February 1999, with more than 100 people attending.

Common Criteria (CCs) allow the construction of protection profiles (PPs) for healthcare information technologies. These profiles will provide a functional description and reference to standards by which the security of a healthcare information technology system can be measured. Use of CCs to develop PPs also will be advantageous to U.S. companies by allowing them to compete with international companies which currently use the Common Criteria.

NIST is developing draft methodology and healthcare security architecture to assist forum member activities. The architecture is designed to help identify and guide the development of a family of PPs supporting the healthcare community. The forum initiated a number of other projects, including developing a NIAP-sponsored prototype Protection Profile for a Healthcare Provider Intranet, economic analyses of the Common Criteria paradigms, and community awareness building of the value of Common Criteria paradigms to address security problems, specification, and compliance measurement.

A meeting of the Forum on Privacy and Security in Healthcare was held in September 1997 at NIST. The purpose of the meeting was to report on the progress and results of the NIST draft methodology and healthcare security architecture, the NIAP-sponsored prototype Protection Profile, and the economic analysis of the CC paradigm.

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NIST CO-SPONSORS WORKSHOP ON INDUSTRIAL MATHEMATICS

NIST co-sponsored a workshop on Mathematical Problems in Industry (MPI), which was hosted by the University of Delaware in June 1999. The event brought together applied mathematicians and scientists from universities, government laboratories, and industry to work on previously unsolved mathematical problems posed by industrial representatives during an intensive 1 week workshop.

More than 50 mathematicians and scientists attended from the United States, the United Kingdom, and Finland, including several NIST staff and guest researchers.

The MPI workshops provide a unique opportunity for government and academic mathematicians to be exposed to real problems of current concern to industry. Industrial participants not only benefit from progress on the solution to the problems they pose, but they also establish new contacts with applied mathematicians. Planning is currently under way for the next MPI workshop, which will again be hosted by the University of Delaware.

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IMPROVED THERMOMETRY FOR SEMICONDUCTOR PROCESSING

NIST researchers presented the results of their work to improve the accuracy of temperature measurement of silicon wafers during rapid thermal processing (RTP) at TEMPEKO 99, The International Conference on Temperature and Thermal Measurements in Industry and Science, Delft, The Netherlands. This project has developed novel thin-film thermocouple technology for measuring the temperature of silicon wafers with an uncertainty of 0.5 K traceable to the ITS-90. This represents an improvement over present practice of using wire thermocouples by a factor of three and, for the first time,

allows traceable calibration of radiation thermometers, the sensor of choice for production tools, with an uncertainty of 2 K. The results of this study provide the semiconductor device and equipment manufacturing communities with the understanding that the temperature measurement accuracy requirements set forth in the National Technology Roadmap for Semiconductors can be met. This improved capability allows device manufacturers to establish more reliable temperature scales for their device recipes in global-wide manufacturing facilities. NIST also is developing models to characterize the radiation environment in RTP tool environments to account for wafer emissivity variability and intereflections between wafer and chamber surfaces.
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NIST ASSUMES VAMAS SECRETARIAT

The Versailles Project on Advanced Materials and Standards (VAMAS) was created in 1982 to support trade through international collaboration in prestandards research in advanced materials. VAMAS has become self-sustaining through Memoranda of Understanding signed by Canada, France, Germany, Italy, Japan, the United Kingdom, United States, and the EC. Linkages between VAMAS and national/international standards organizations such as ISO and IEC have been established. VAMAS is governed by a steering committee consisting of up to three individuals from each of the member countries. Decisions are reached by consensus among the members. In May of this year, NIST assumed the role of the VAMAS Secretariat for the next 3 years. In this capacity, a NIST staff member takes on the position of chair of the steering committee, and another becomes its secretary. The work of VAMAS is carried out within Technical Working Areas (TWAs). There are currently 16 TWAs addressing a wide range of material subjects, e.g. surface chemical analysis, ceramics, polymer matrix composites, fatigue, etc. VAMAS is in the process of developing a Strategic Plan, which will lead to new avenues of endeavor and new mechanisms for delivery of needed information.
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NEW HISTORICAL WEB SITE ON MARIE CURIE AND THE NBS RADIUM STANDARDS

NIST has a new historical web site (http://physics.nist.gov/Curie) on Marie Curie and the U.S. national standards for Radium-226. The web site was prepared as a contribution to the centennial celebrations for NBS/NIST to take place in 2001 and is illustrated with period photographs as well as certificates and photographs from the NBS archives.

In December 1913, the International Radium Standards Commission, which included Marie Curie, Ernest Rutherford, and Stefan Meyer, distributed a set of international standards of radium to a select group of national standardizing laboratories. Specimen Number 6, containing 21.50 mg of radium chloride, was sent to the National Bureau of Standards (NBS) in Washington, DC. In 1914, NBS began to offer calibrations of radium-226 for chemical processors and radium source manufacturers by comparison with this national standard. In 1921 Marie Curie visited the United States for the first time. Among many sites visited during her trip were the radium refining facility of the Standard Chemical Company of Pittsburgh, the Bureau of Standards in Washington, and finally the White House. In a ceremony at the White House, President Harding presented her with a certificate for one gram of radium that had been donated by the women of America. The staff of the Radium Section at NBS certified the content of the 10 individual ampoules, prepared the certificate, which was signed by S.W. Stratton, the first director of NBS, and packaged the samples and delivered them to the ship that Marie Curie took on the return to France.
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COOPERATION YIELDS BETTER UNDERSTANDING OF ALTERNATIVE REFRIGERANTS

In 1990, the International Energy Agency established a program called Annex 18 to consider the thermophysical properties of the leading environmentally acceptable alternatives to the environmentally unfriendly chloronated fluorocarbons (CFC) refrigerants. The objectives were to provide a forum in which information and data could be exchanged, and the representation of refrigerant fluids could be standardized through the publication of comprehensive, internationally accepted property formulations. NIST, representing the United States, acted as the coordinator for the eight countries that participated in the activities of Annex 18 while Japan assisted in coordinating two phases of the work.

Annex 18 has completed its work, which resulted in the adoption of international standards for the thermodynamic properties for the refrigerants R134a, R123, R32, R125, and R143a. Evaluations of property models for mixtures of these fluids facilitated the adoption of a new approach for computing the thermodynamic properties of mixtures. The evaluations, and the underlying

data surveys and compilations, have contributed to many national and international property compilations. The net result is reduced uncertainty (and variation among sources) for the property values used by refrigeration design engineers.

Further work remains because new fluids and mixtures are being proposed continually. Refrigerant mixtures, especially, present needs for additional data and comprehensive models.

A paper outlining the issues and results serves as the final report for Annex 18; it is available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3337; (303) 497-3237; sarabeth@boulder.nist.gov. Ask for paper no. 28-99.

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EMERGING DVD STANDARDS TO BE FOCUS OF WINTER MEETING

Digital versatile disc, or DVD, technology is beginning to provide a stunning new way to store everything from short songs downloaded from the Internet to lengthy movies.

A typical DVD can hold seven to eight times as much information as a compact disc of the same physical size. DVDs can store music, film, computerized information and, in the future, digitized x rays and other medical images. The growth of this new industry will depend, to some extent, on cooperation among manufacturers. Consumers will want to be able to use any DVD in any DVD player, in the same way that they can use a CD in any commercially available CD player.

NIST is holding a workshop to examine emerging industry standards that could be critical to the success of the DVD industry. Workshop speakers will include executives of major American and Japanese companies with an interest in the industry. The workshop will address issues such as copyright protection in relation to MP3, emerging DVD authoring technologies, electronic books, and web-based DVD products.

The workshop, co-hosted by the Optical Storage Technology Association, will take place Nov. 30-Dec. 1, 1999, at NIST in Gaithersburg, MD. More information is available at www.nist.gov/dvd99.

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PROPOSALS SOUGHT FOR PRECISION MEASUREMENT GRANTS

NIST is seeking project proposals for two research grants for fiscal year 2001 in the field of precision measurement and fundamental constants. NIST Precision Measurement Grants are awarded each year to faculty members of U.S. universities or colleges for work in determining values for fundamental constants, investigating related physical phenomena or developing new, fundamental measurement methods. Each Precision Measurement Grant of $50,000 for 1 year may be renewed by NIST for up to 2 additional years for a total of $150,000.

Prospective candidates must submit summaries of their proposed projects and biographical information to NIST by Feb. 1, 2000. The application should include a pre-proposal summary of not more than five double-spaced pages outlining the objective, motivation, and technical approach of the research and the amount and source of current funding for the research, together with a concise biographical sketch of the applicant and a list of the applicant's most important publications.

On the basis of this material, four to eight semifinalists will be selected to submit more detailed proposals.

Submit 10 copies of the pre-proposal summary to Barry N. Taylor, NIST, 100 Bureau Drive, Stop 8401, Gaithersburg, Md. 20899-8401. For more information, contact Taylor at (301) 975-4220, or visit the Precision Measurement Grants World Wide Web page at physics.nist.gov/ResOpp/grants/grants.html.

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NEW MICROTRAPS BETTER CAPTURE THE ELUSIVE LASER-COOLED ION

Tinier is better in the minuscule world of trapped ions, which are used in research on quantum entanglement and quantum computing. The more closely confined the ions, the more precisely they can be manipulated. NIST has developed a method of constructing ion traps using gold-on-ceramic lithographic techniques, which enables smaller, more precise and more complex geometries than standard machining techniques.

The new microtraps have been used to trap and crystallize small numbers of laser-cooled ions. Tightly focused laser beams then drive individual ions into desired quantum states and interrogate their state. One experiment trapped two ions only 5 μm apart, with a laser beam illuminating only one ion at a time.

Another experiment shuttled ions along the axis of the trap and separated them by applying pulsed voltages to the trap electrodes. This technique may relax the laser focusing requirements for quantum logic gates and individual ion detection and may lead to trapping more complex arrays of ions by moving ions between accumulators.

For more information, contact Chris Myatt, (303) 497-7295, myatt@boulder.nist.gov.

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SAVE TIME, DOLLARS IN SELECTING NEW MANUFACTURING TECHNOLOGIES

Manufacturing Efficiency Decision Support (MEDS) is a new web-based tool that can help manufacturers, technical assistance providers and others quickly and easily compare and evaluate manufacturing technologies. The MEDS web site is at http://meds.mmtc.org.

MEDS provides users with information on the performance, cost, energy and environmental implications of more than 175 technologies in areas such as fabricated metals, plastics and electronics. Background information, economic and technical feasibility, case studies and vendor information are provided for each technology. MEDS also allows users to conduct "what if" analyses by altering key variables, such as budget constraints.

MEDS was developed by the Michigan Manufacturing Technology Center with funding from NIST's Manufacturing Extension Partnership. NIST MEP is a nationwide network of non-profit centers serving small manufacturers in all 50 states, the District of Columbia and Puerto Rico.

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NIST LAUNCHES CONFORMITY ASSESSMENT WEB SITE

A soup (canned, that is) to nuts directory of the hundreds of products, services and systems subject to federal certification requirements and procurement standards is one of many resources featured on a newly launched NIST web site (ts.nist.gov/ca) devoted to conformity-assessment issues, programs and procedures. The goal of the new site is to provide one-stop shopping for conformity assessment information.

The web site features the 1999 edition of NIST's *Directory of Federal Government Certification and Related Programs,* a document summarizing requirements issued by the U.S. Departments of Agriculture and Transportation, the Federal Communications Commission, and 15 other departments and independent agencies. Entries describe the purpose of each requirement, whether it is mandatory or voluntary, and methods used to ensure compliance. Also listed are sources of documentation, reciprocity arrangements, enforcement approaches and other items. The directory covers a wide range of products and services, including such diverse items as drinking water, motor fuels, building products and communications satellites.

NIST developed the new web site in cooperation with the recently formed Conformity Assessment Network (CAN). CAN is a government and private-sector partnership created to improve businesses' and consumers' understanding of the various and sometimes confusing procedures used to assess the worthiness of products and services. Testing, sampling, inspection, certification, and other conformity assessment methods are intended to verify that a particular product meets a specified level of quality or safety or to accomplish other aims. They also can influence market entry and business competitiveness.

For more information on the directory (NIST SP 739, 1999 edition), the new web site, or CAN, contact Maureen Breitenberg, NIST Global Standards Program, (301) 975-4031, maureen.breitenberg@nist.gov.

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WANT TO KNOW EVERYTHING ABOUT PRINTED WIRING BOARDS? ASK NIST!

Printed wiring boards (and substrates) are ubiquitous in radio-frequency and microwave equipment, and accurate knowledge of their dielectric and magnetic properties is essential to designing this equipment. As electrical components are miniaturized, the need for accurate low-loss dielectric measurements on thin materials becomes even more important.

NIST has published an overview of the entire topic of printed wiring board technology, including such features as descriptions of the materials employed and lamination geometries, tables of thermal properties, conductor conductivities, dielectric constants and loss tangents for many materials. Also included are the equations used to model and measure material properties and behavior. Ten different measurement methods are described in detail with diagrams of fixtures, charts and tables of results for many materials and geometries. An extensive bibliography also is included.

Dielectric and Magnetic Properties of Printed Wiring Boards and Other Substrate Materials (NIST Technical Note 1512) is available from Bill Riddle, NIST, MC 813.01, Boulder, CO 80303-3337; (303) 497-5752; riddle@boulder.nist.gov.

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NIST-SPONSORED NIUF SUCCESSFULLY COMPLETES ITS WORK

On Aug. 21, 1999, the North American ISDN Users Forum (NIUF) closed its doors after 11 years of providing users of Integrated Services Digital Network (ISDN) an open industry forum to resolve issues and develop applications and implementation agreements. The NIUF held its 36th and final meeting in Montreal in June 1999, to complete the final approval of documents and to celebrate the success of the NIUF and ISDN in the United States and Canada.

A cooperative research and development agreement (CRADA) signed by NIST and several key ISDN users and industry stakeholders established the NIUF in 1988. Since its inception, NIST hosted the NIUF; provided the NIUF chair, project manager, and Secretariat; provided technical contributions; and maintained the NIUF web site. NIUF accomplishments include:

- providing users the opportunity to influence developing ISDN technologies to reflect their needs;
- identifying over 150 ISDN applications;
- co-sponsoring the Transcontinental ISDN Project in 1992 (TRIP '92), which earned the NIUF and the Corporation for Open Systems (COS) the InfoWorld Publisher's Industry Milestone Award for 1992 Product of the Year;
- developing 21 technical Implementation Agreements and 12 conformance test suites, including three internationally standardized suites;
- developing guidelines for wiring and powering;
- identifying ISDN Order Code packages to simplify ISDN ordering;
- developing a Universal Ordering Form for ISDN to allow consistency of ordering among the Regional Bell Operating Companies (RBOCs) and independent telephone companies; and
- providing an input and feedback mechanism for implementors and users to identify requirements for new versions of National ISDN.

NIST and other NIUF members agreed that the NIUF successfully achieved its goals. ISDN is now a mature technology widely deployed with increasing sales, and ISDN products are widely available in retail stores. NIUF-approved electronic documents are available at http://www.niuf.nist.gov.
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NIST HELPS TO DEVELOP SIMULATION MODELS FOR 3G WIRELESS SYSTEM

NIST and a private company jointly developed simulation models for the cdma2000 system based on the company's communication system design/ simulation tool. An extension of the IS-95 standard for cellular phone systems, cdma2000 is one of the major systems proposed to the International Telecommunication Union (ITU) for the IMT-2000 standard for third-generation wireless systems. IMT-2000 systems promise data rates up to 2 Mbit/s and support a variety of wireless multimedia services such as video conferencing, web browsing, and other forms of data communications, in addition to todays wireless voice, paging, and e-mail services.

The company's simulation tool is an object-oriented language for software development and testing of communication systems. It includes models for many basic building blocks in a communication system. This work combines and extends these building blocks to yield models for the cdma2000 system, based on the proposed standard specifications. These models allow communication engineers to measure the performance of the physical layer of the cdma2000 system over a range of communication channel conditions, e.g., whether the cellular phone user is mobile or stationary, the type of environment the user is in (urban/suburban/countryside), and how much interference the user is getting from other cellular users. This makes it possible to characterize the performance of the cdma2000 system prior to hardware prototyping and expensive field tests. The jointly developed models will benefit smaller companies in the wireless industry, both manufacturers and operators, which do not have the resources to build their own models to test the cdma2000 system in their transition from second-generation to third-generation wireless systems.
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NIST PARTNERS WITH OASIS TO PRODUCE XML CONFORMANCE TEST SUITE

In a July 1999 press release, the Organization for the Advancement of Structured Information Standards (OASIS) announced public availability of the OASIS XML Conformance Test Suite. Jointly produced by NIST and OASIS, the test suite consists of a set of more than 1000 tests that determine the ability of XML parsers to handle test cases built on the W3C Recommendation. The XML Conformance Test Suite can be downloaded from http://www.nist.gov/itl/div897/ctg/xml/index.htm.

The XML Conformance Test Suite incorporates tests developed by NIST and the OASIS technical committee with those contributed by others. Utilizing an approach defined by committee members, NIST staff built the test suite as it currently exists. Each set of contributed tests was validated against a set of locally installed parsers and augmented with test descriptions and pointers to the specific production under test, ensuring that each test was well-grounded in the recommendation. This information was encapsulated in an XML test description file for each set of tests and generated into a report using the supplied XSL stylesheets.
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TWO NIST INTERCONNECT RELIABILITY TEST CHIPS DEVELOPED

NIST researchers have designed and fabricated interconnect reliability test chips that will improve greatly existing reliability standards and provide the basis for developing new ones. These test chips are crucial for determining the interconnect reliability of future generation integrated circuits. The goal for this metrology is to provide optimally designed test structures and measurement methods. These measurement tools would identify measurement interferences, provide methods for data analysis, state requirements for assuring complete and unambiguous test reports, explain any underlying assumptions of the test, and provide procedures for calculating confidence intervals for every reliability measure of the test. This addresses the concern expressed in *The National Technology Roadmap for Semiconductors,* 1997 edition, which states "Significant gaps and deficiencies in the tool set exist for reliability test structures and methods. Characterization of electromigration in submicrometer sized lines, contacts and via structures under DC, and pulse conditions will be required."

The NIST 33 and NIST 36 test chips are a collection of test structures designed in collaboration with members of JEDEC (Joint Electron Device Engineering Council) Committee JC14.2 on Wafer Level Reliability and with industry researchers. JEDEC is the semiconductor engineering standardization body of the Electronic Industries Alliance (EIA), a trade association that represents all areas of the electronics industry. JEDEC was created by EIA in 1958 to cover the standardization of discrete semiconductor devices and later expanded in 1970 to include integrated circuits.

NIST 36 contains a variety of single-level metal- and via-type electromigration test structures for evaluating the designs of these test structures and their use in test methods to characterize the reliability of interconnects. It also includes structures to measure stress voiding, electro-migration-driven noise, metal sheet resistance and linewidth, and oxide thermal conductivity. The availability of via-type test structures on NIST 36 is intended to stimulate critically needed activities in JEDEC for the development of metrology tools for characterizing stress voiding and electromigration in vias.
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NIST INNOVATION IMPROVES QHR DEVICE PERFORMANCE

Since 1990, the quantum Hall effect (QHE) has, by international agreement, been used to realize representations of the SI unit of resistance, the ohm. At low temperatures, and in the presence of a large magnetic field, the resistance of a two-dimensional conducting sheet is quantized and takes values determined solely by fundamental physical constants. Quantum Hall resistance (QHR) standards based on this effect can be extremely accurate. There has, however, been a continuing problem in the manufacture of devices with sufficiently high quality to serve as resistance standards—namely, making reliable electrical contact to the two-dimensional electron gas (2 DEG) in the AlGaAs/GaAs heterostructures employed to create and confine the conducting sheet. Research at NIST has led to two innovations that will enable the design and manufacture of improved devices for QHR standards.

Careful measurements have shown that the quality of these critical electrical contacts is adversely affected by defects, both in the heterostructure and in the thin inter-facial region between the metal contact and the heterostructure. These defects can be created when the device is made, during the formation of the contact, when attaching wires to the contacts, and also by continued corrosion after the device is made. This work indicated that the application of an electrically insulating coating covering the top surface of the heterostructure and the edges of the electrical contact pads would prevent corrosion of the heterostructure and the contacts. Previous attempts to protect the devices with such coatings resulted in devices that exhibited parallel conduction causing the devices resistance to differ from its ideal value. Calculations performed at NIST indicated that the parallel conduction could be eliminated by a slight change in the design of the heterostructure from which the devices were made. Recent, independent work in France has demonstrated the feasibility of making QHR devices with protective Si_2N_4 coatings that do not have parallel conduction at temperatures as high as 1.4 K, in confirmation of NISTs work.

Additional work at NIST demonstrated that the commonly used technique of directly bonding wires to electrical contact pads over the heterostructure creates electrically active defects in the contact region, which also adversely affects device performance. A relatively simple modification was found to effectively eliminate this problem: a large, thick metal bonding pad is deposited, completely covering the alloyed electrical contact to the heterostructure and extending over the semi-insulating substrate region. Wires connecting the device to the measurement system can then be bonded to these pads over the substrate, preventing any damage to the sensitive heterostructure. The larger bonding pads also reduce the introduction of water vapor into the contact region and the consequent corrosion at this critical interface. NISTs improved technique recently has been used by a French company to prepare

standards-quality quantized Hall resistors for national metrology laboratories. These innovations will benefit both NIST and standards laboratories around the world by increasing the reliability of QHR standards.
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DIRECT COMPARISON OF QUANTUM HALL RESISTANCE STANDARDS

In April 1999, NIST researchers and the Bureau International des Poids et Mesures (BIPM) carried out a first comparison of their primary resistance standards using a traveling quantized Hall resistance (QHR) system. Since 1990, QHR systems have been used by a large number of national metrology institutes to maintain their units of resistance. Intercomparisons between these systems have been performed through the exchange of traveling reference resistance standards. Temperature effects, drift, and unexplained shifts in the values of the standards over the duration of the comparison have limited the accuracy of these comparisons. To minimize these detrimental effects, the BIPM has developed a complete QHR measurement system that can be transported to national metrology laboratories. This is the first on-site comparison for which the system was shipped by commercial carrier; for previous comparisons in Europe, the equipment was transported specially in BIPM vans. The QHR system includes a cryostat and pumped ^{4}He low temperature insert, superconducting magnet, two QHR samples mounted on a cryogenic probe, standard resistors, and a room-temperature ac-resistance-ratio bridge. During this comparison, measurements of the quantized Hall resistance on the two systems agreed to within their relative combined uncertainties of about 2×10^{-9}.

This work helps verify the assigned uncertainty of NIST's realization, scaling, and dissemination of the unit of resistance, which is needed to support a large number of customer calibrations of Thomas-type 1 Ω standards, special 10 kΩ standards, and special 100 Ω calibrations for the NIST watt balance/electronic kilogram experiment.
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CHANDRA CAPTURES FIRST IMAGES

NASA's newest space-based telescope is the Chandra X-Ray Observatory. Prior to its launch aboard Space Shuttle flight STS-93, the telescope was calibrated at Marshall Space Flight Center using a unique monochromator produced at NIST. Researchers at NIST designed, built, and tested a unique double-crystal monochromator (DCM) used for wavelength and sensitivity calibration of the telescopes detectors. Matching pairs of crystals were mounted on automated pentagonal turrets that rotate and translate to provide x-ray energy scans and other tests. During the telescope calibration studies, the NIST DCM and a rotating-anode x-ray source are connected to the Chandra X-Ray Observatory by a 500 m vacuum pipe. The NIST DCM and calibration activities are further described at http://wwwastro.msfc.nasa.gov/xray/xraycal/xssrr/dcm. The first image from the new x-ray telescope shows such stunning detail that scientists can see evidence of what may be a neutron star or black hole near the center of a gigantic stellar explosion. This image appeared in *Newsweek* and may be seen along with other updates at http://chandra.nasa.gov.
CONTACT: Richard Deslattes, (301) 975-4841; richard.deslattes@nist.gov or Larry Hudson, (301) 975-2537; lawrence.hudson@nist.gov.

CHANDRA X-RAY OBSERVATORY FLIES NIST-CALIBRATED SPECTROMETER

The Chandra X-Ray Observatory was deployed into orbit from the Space Shuttle Columbia on July 23, 1999, and in the process put into service the first measurements to be referenced to the NIST-developed Molecular Measuring Machine. The Chandra X-Ray Observatory (CXO) will allow scientists from around the world to obtain unprecedented x-ray images and spectra of violent, high-temperature events and objects to better understand the structure and evolution of the universe. The diffraction gratings used in the spectrometer of the CXO were measured with reference to special measurements done on the Molecular Measuring Machine. One of the sub-micrometer pitch reference gratings was determined to have an average pitch of 400.80 nm with an expanded uncertainty (coverage factor, $k = 2$) of 20 pm. The other was determined to have an average pitch of 200.01 nm, with expanded uncertainty 10 pm.
CONTACT: John Kramar, (301) 975-3447; john.kramer@nist.gov.

PATENT AWARDED—TIME AND POLARIZATION RESOLVED ACOUSTIC MICROSCOPE

The time and polarization resolved acoustic microscope enables convenient detection of material defects, characterization of surface properties, and measurement of material properties such as the elastic modulus. Rather than use a lens, as is typical for traditional acoustic microscopes costing hundreds of thousands of dollars, the time and polarization resolved acoustic microscope

uses a curved transducer made with an inexpensive piezoelectric plastic film, resulting in a microscope costing tens of thousands of dollars. The curvature of the transducer focuses the sound waves that it emits, eliminating the need for lenses. This transducer provides both time and polarization resolved capabilities. Time resolving utilizes very short duration "pulse" ultrasonic waves, as opposed to the longer duration tone bursts needed by traditional acoustic microscopes in order to achieve an acceptable signal to noise ratio. Polarization resolving results in waves that are directional with respect to the material so that directional variation in material properties, such as anisotropic elasticity, can be detected. The microscope, which earned a U.S. patent for three NIST researchers in July 1999, has been applied to the measurement of composite materials, single-crystal wafers, plasma-sprayed ceramic coatings, steel alloy properties, and crack sizing.

CONTACT: Nelson Hsu, (301) 975-6630; nelson.hsu @nist.gov.

DIODE-LASER/ATOM-BASED METROLOGY COLLABORATION

Researchers at NIST have succeeded in performing the first direct interferometer-based lateral measurements on an atomically resolved surface. This effort is intended to build an unbroken traceability chain for the development of atom-based standards. A diode laser interferometer was successfully fitted to an ultrahigh-vacuum scanning-tunneling-microscope in order to measure tunneling tip lateral displacements. Atomic resolution images of a graphite surface were first obtained in air using the diode laser interferometer. The system was mounted subsequently in vacuum and the interferometers tested at a pressure as low as 2.7×10^{-6} Pa). Use of this nominally 10 pm resolution interferometer is expected to enhance and accelerate the development of linewidth and pitch artifacts whose dimensions can be based on the atom spacings.

CONTACT: Lowell Howard, (301) 975-3227; lowell. howard@nist.gov or Rick Silver, (301) 975-5609; richard.silver@nist.gov.

NIST DEVELOPS TECHNIQUE FOR MEASURING RADIOACTIVE CORONARY STENTS

Approximately half a million coronary angioplasty procedures are performed in the United States each year. In up to 50 % of these cases, the patient will experience restenosis, or re-closing, of the artery walls. One method used to prevent this restenosis is the placement of a metal stent that expands to form scaffolding to hold the artery walls open and is left in place after the procedure. Unfortunately, this has not proven effective in every case and a re-examination of the site will often find scar tissue growing through the stent. Another method employed to reduce restenosis is through irradiation ("intravascular brachytherapy"). Doses at the level used long have been known to inhibit proliferative cells, such as scar tissue. Recently, a private company has combined these two methods by developing a stainless steel stent containing the radioactive beta-emitting phosphorus-32. In order for correct dosimetry calculations to be performed, and as a check of the manufacturing process, it is necessary for the activity contained in these stents to be measured directly and accurately.

A series of 36 stents of different lengths and with different activity levels was supplied to NIST. The stents were measured and intercompared with a NaI(Tl) γ-ray scintillation detector. Some of the stents then were digested slowly and quantitatively with a small amount of hydrofluoric acid. The activities of aliquots of this solution then were measured by liquid-scintillation counting using the standard method developed in part by NIST. The resulting activity concentration was multiplied by the total mass of the digestion solution to give the total activity originally contained in the stent. This subset of stent activities then was used to derive calibration factors for the NaI(Tl) well counter, which in turn were used to derive the total activity contained in the remaining undigested stents. The activities will be reported to the private company with an expanded ($k = 2$) uncertainty of 1.1 % to 2.1 % for the digested stents and 1.5 % to 2.6 % for the undigested stents.

CONTACT: Jeffrey T. Cessna, (301) 975-5539; jeffrey. cessna@nist.gov.

NIST CALIBRATES NOVEL PARTICLE ETECTORS FOR USE IN SPACE

The two electron accelerator facilities at NIST are capable of providing beams over a wide range in electron energy. The Van de Graaff accelerator produces beams ranging from about 500 keV to approximately 2.5 MeV, and the Medical Industrial Radiation Facility (MIRF) linear accelerator covers a range of 7 MeV to 32 MeV. Often, researchers need to investigate both the low- and high-energy performance of their equipment. A private company exploited the capabilities at NIST in a recent series of measurements. Both accelerators were used in the calibration of charged-particle sensors for electron energies ranging from 500 keV up to 32 MeV. NIST was able to meet the strict beam-quality requirements of the users, allowing them to evaluate the response of the sensors over a three-decade range in

energy. These sensors are designed for use in space-flight applications to measure light-charged-particle spectra encountered in Earth orbit. Some of these detectors have been placed aboard commercial and government satellites, and there are plans to use them on the International Space Station. Consisting of solid state and scintillator elements, the light-particle-monitor (LPM) is able to identify and energy-analyze electrons, protons, and alpha particles over a wide range in energy simultaneously. Previously, separate sensors had to be used to monitor electrons and protons. The key to the capabilities of the LPM lies in a proprietary signal-processing algorithm. The private company soon will return to NIST to test a new prototype detector currently under development. Knowledge gained from these calibrations will help researchers refine the present generation of detectors and aid in the design of future prototypes.

CONTACT: Fred Bateman, (301) 975-5580; fred.bateman@nist.gov.

NIST ASSISTS CDC IN RADIATION DOSIMETRY OF A RADIUM NASOPHARYNGEAL APPLICATOR

In 1939 the use of radium applicators was introduced to treat hyperplastic nasopharyngeal lymphoid tissue to prevent hearing impairment in children who suffered from chronic or recurring Eustachian tube obstruction. During World War II, this technique also was used on airmen and submariners who suffered from aerotitis media, or barotrauma, which is caused by the inability of the body to equalize the pressure between the middle ear and the surrounding atmosphere. For both of these medical conditions it was felt that shrinkage of the lymphoid tissue near the Eustachian tube orifice would reduce the symptoms and potentially prevent recurrence. Before being discontinued around 1960, an estimated 1/2 to 2 million children and servicemen received these treatments, which involved rather large radiation doses to the head, being equivalent to approximately 1000 to 10 000 dental x rays.

In the last few years, there has been growing concern and considerable controversy about the effect of these irradiations on the subject population. Much of the uncertainty in this epidemiology concerns the actual delivered doses. While the dosimetry of more heavily shielded radium applicators is very well understood, applicators used for this therapy were specially designed with thinner encapsulation to increase the beta radiation component to better localize the delivered dose to the lymphoid tissue. Unfortunately, accurate dosimetric measurements of beta radiation fields are very difficult and imprecise near such small sources, so there is considerable uncertainty in the dose that was delivered. NIST is the recognized world leader in the dosimetry of small beta particle sources, such as reactor-generated "hot particles," ophthalmic applicators, and intravascular brachytherapy sources. To help resolve the controversy in the dosimetry of the nasopharyngeal applicators, NIST began a collaboration with the Centers for Disease Control (CDC) in Atlanta. CDC investigators arranged for NIST to receive a radium applicator typical of those used for such treatments. Dosimetry measurements were performed with this source using high-resolution radiochromic film densitometry. The measurements indicate that the delivered beta-particle doses were 30 % to 40 % higher than the best previously available estimates. These results will allow epidemiologists to better understand cohort studies of the affected population.

CONTACT: Christopher Soares, (301) 975-5589; christopher.soares@nist.gov.

IMAGING NANOSCALE MAGNETIZATION DYNAMICS

NIST researchers have reported recently in the *Journal of Magnetism and Magnetic Materials* that scanning electron microscopy with polarization analysis (SEMPA) could be used to image magnetic domain dynamics on the nanoscale. Imaging the response of magnetic domains to an applied magnetic field is essential for understanding how most magnetic storage devices and sensors work. Traditionally, magneto-optic imaging methods have been used to image magnetization dynamics. The spatial resolution attainable with these methods is fundamentally limited by optical diffraction to scales of the order of the wavelength of light (several hundred nanometers). Electron-microscopic methods, such as SEMPA, have much less restrictive fundamental limits, but the electron imaging can be distorted by stray magnetic fields.

By using a specially designed sample holder with the sample configured in a closed magnetic circuit, the NIST researchers found that the applied magnetic fields could be confined to the sample and SEMPA could successfully image the magnetization dynamics without loss of resolution. The initial measurements examined domain wall motion in amorphous metal ribbon materials used for transformer cores. Although these measurements used low-frequency magnetic fields, the images clearly showed domain wall interactions with defects and the different mobilities of various domain walls. The SEMPA images also showed that much of the domain wall motion was not reproducible after cycling the magnetic field. This irreproducibility is a serious problem for imaging of the magnetization dynamics at

high frequencies, since most high-speed imaging methods use stroboscopic techniques, which, in turn, rely on reproducible domain motion.
CONTACT: John Unguris, (301) 975-3712; john.unguris@nist.gov.

ABSOLUTE DETECTOR-BASED RADIANCE TEMPERATURES

Researchers at NIST have shown that the thermodynamic temperature of a blackbody can be measured directly using filter detectors calibrated for absolute spectral power response. Using the absolute calibrated filter detectors, they have measured the radiance temperature of the variable-temperature blackbody used in the dissemination of the U.S. National Scale of Radiance Temperature.

The absolute spectral power response is derived from the NIST high-accuracy cryogenic radiometer (HACR) and measured in the NIST Spectral Comparator Facility. The radiance temperature is determined using a measurement equation that describes the relationship between the measured signal and the blackbody radiance temperature. The NIST researchers compared the results of the absolute detector-based method with the temperatures obtained with the NIST photoelectric pyrometer (PEP), which determined the radiance temperatures using the methods of ITS-90. The detector-based radiance temperature determinations are in agreement with the measurements of the PEP to within 0.5 K in the range of blackbody temperatures from 2200 K to 2800 K, and are within the mutual uncertainties of the measurements. Furthermore, the uncertainties in radiance temperature using the new technique can be reduced greatly compared to those found using ITS-90 techniques.

Since the U.S. national radiance temperature scale, as well as the spectral radiance and spectral irradiance scales are all based on the absolute radiance temperature determination of the freezing point of gold, any reduction in the radiance temperature uncertainty immediately impacts all three scales. Work is under way to use the new absolute detector-based radiance temperature meas-urements in the realization of a new spectral irradiance scale.
CONTACT: Howard Yoon, (301) 975-2482; howard.yoon@nist.gov or Charles Gibson, (301) 975-2329; charles.gibson@nist.gov.

NIST DEVELOPS MEASUREMENT FOR EXCHANGE BIASING

NIST researchers have developed new methods of measuring the effectiveness of thin antiferromagnetic films for exchange biasing. For a number of magnetic field sensing devices which use the giant magnetoresistance effect, such as the read head in computer hard drives, it is important to be able to "pin" the magnetization of one ultrathin magnetic film, while allowing the magnetization in a parallel film, just a few nm away, to rotate in response to a small applied field. To accomplish the pinning, the pinned film is often deposited in contact with a film of antiferromagnetic material, which is magnetically ordered; but because it has alternating layers of oppositely directed spins, it has no net moment, so it is not easily affected by applied fields. Because the antiferromagnet does not interact strongly with applied fields it can serve as the "anchor" for a ferromagnetic film coupled to it through their common interface.

Using ferromagnetic resonance, a form of spin resonance related to electron spin resonance, NIST researchers have developed a technique to assess the stability of antiferromagnetic films. The desirable exchange bias effect due to stable portions of the anti-ferromagnet and the NIST-discovered rotatable anisotropy effect due to unstable portions of the antiferromagnet have been measured for a number of technologically and scientifically important antiferromagnetic materials. For example, the results for NiO, a popular material for exchange biasing, indicate that the rotatable anisotropy effect is much larger than the exchange bias effect and suggest that there is room for improvement in exchange bias through enhanced stability of the NiO spin order.
CONTACT: Bob McMichael, (301) 975-5121; robert.mcmichael@nist.gov.

NEUTRON DIFFRACTION MEASUREMENTS ESTABLISH CONNECTION BETWEEN HIGH-TEMPERATURE SUPERCONDUCTIVITY AND MAGNETISM

Lanthanum copper-oxides can either exist as insulating antiferromagnets or as superconductors, depending on "doping," i.e., on whether oxygen has been added or depleted from this material. The connection between magnetism and superconductivity in these copper-oxides has been clarified recently by magnetic neutron diffraction measurements at the NIST Center for Neutron Research (NCNR).

For several years, it has been suggested that the superconducting state in these materials is associated with magnetic "fluctuations," i.e., magnetism that varies in time. Now, as emphasized in a recent "Perspective" in the journal *Nature,* a kind of static magnetic order has been observed that is related directly to the superconducting state.

Neutron diffraction displays magnetic order that sets in at the same temperature as the ordering of electrons into the superconducting state, suggesting a strong correlation between the two phenomena. Moreover, the NCNR measurements show that the periodicity of the order (which is not in registry with the underlying crystalline lattice) is related to the "dopant" concentration.
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GUIDE FOR PORTABLE EXPLOSIVES DETECTION SYSTEMS

A survey and evaluation of commercial, portable explosives detection systems for law enforcement applications was completed. The project was carried out by NIST staff in collaboration with Sandia National Laboratories. The result of this work was written as the National Institute of Justice (NIJ) Guide, NIJ Guide 100-99, and was approved for publication in June 1999.

Once the guide is published by NIJ, it will be available to national enforcement agencies to help them make procurement decisions in purchasing equipment as part of the national counterterrorism program.
Contact: Alim A. Fatah, (301) 975-2757; alim. fatah@nist.gov.

TEST PROTOCOL FOR PROTECTIVE GLOVES

A test protocol for protective gloves for use by national law enforcement corrections personnel was completed and issued as a National Institute of Justice (NIJ) Test Protocol, NIJ Test Protocol 99-114, in June 1999. This test protocol is the culmination of more than 2 years of effort by NIST working with users, glove manufacturers, and standards organizations.

Now that the test protocol is completed, the National Law Enforcement and Corrections Technology Center will initiate a national voluntary testing program of protective gloves and make the results available to law enforcement and corrections agencies to help them make informed decisions when procuring protective gloves for their officers.
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NEW GUIDE WILL HELP SIREN BUYERS

To a law-abiding driver, its simple: when you hear a siren, you pull over and let the emergency vehicle pass. Agencies that buy sirens face a more technical set of questions: will the siren make that distinctive wee-ooh wee-ooh, and will it be loud enough? Will it cause hearing loss to those who ride in emergency vehicles every day? To answer these questions, siren purchasers need to know some basics of sound measurement and know something about the industry standards for sirens. Three siren standards are in current use in the United States and may be referred to by siren vendors.

The National Institute of Justice (NIJ) soon will publish a new guide for siren buyers, researched and written by a NIST staff member. Formally known as "Guide to Test Methods, Performance Requirements, and Installation Practices for Electronic Sirens Used on Law Enforcement Vehicles," NIJ Guide 500-99, this booklet compares the existing standards. It gives a technical description for the official wee-ooh sound, known as a wail, as well as the faster changing sound called a yelp. It explains simple acoustic testing methods, siren features, and practices to minimize hearing loss. A committee of the Society of Automotive Engineers (SAE), which publishes one of the standards, is working toward an update, with new rounds of testing on sirens, measuring equipment, and so forth.
CONTACT: James Worthey, (301) 975-3396; james. worthey@nist.gov.

MAJOR IEC REPORT COMPLETED BY NIST EDITOR

As a contribution to the development of international standards, a NIST staff member has completed his 3 year term as editor of a technical report for the International Electrotechnical Commission (IEC), entitled *General Basic Information Regarding Surge Overvoltages and Surge Protection in Low-Voltage AC Power Systems.* The report, developed by a joint working group appointed by five IEC Technical Committees, now will be circulated among the IEC national committees. The report provides basic information on the origins and mitigation of surge voltages in low-voltage ac power circuit. This pilot information will be incorporated in other publications and standards by the five technical committees to ensure harmonization of concerns that previously had been uncoordinated. The technical as well as editorial contributions from NIST to this process drew on the experience accumulated in the course of NIST power quality work, and surge mitigation in particular. In a field that is strongly influenced by the practices of European utilities and manufacturers, the presence among the working group of a strong representation of the U.S. practices helped make the recommendations of this report more globally acceptable.
CONTACT: James K. Olthoff, (301) 975-2431; james. olthoff@nist.gov.

NEW TECHNOLOGY BATTERIES GUIDE FOR NIJ PREPARED BY NIST

The law enforcement and corrections communities rely heavily on portable electronic and electric equipment to efficiently execute many of their required duties. The proper operation of such equipment in field use depends to a great extent on the performance of the batteries which power them. NIST recently prepared for National Institute of Justice (NIJ) publication the New Technologies Battery Guide, NIJ Guide 208. This publication, written in nontechnical language, addresses the potential user of battery-operated police communications and evidence-gathering equipment. Electronic and performance trade offs are discussed to help select the appropriate battery for use in mobile radios, cellular phones, laptop computers, camcorders, etc. Also, examined are procedures for handling, maintaining, and disposing of batteries.

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NIST FOCUSES ON EMERGING TECHNOLOGY OF SMART ENVIRONMENTS

Tomorrow,s smart environments will help people achieve their tasks through intelligent information interaction, aided by computers and sensors. Smart environments typically involve a large number of communicating distributed computers and sensors, some carried or worn by mobile individuals, others embedded in the environment to create a richly augmented space. In July 1999, the Defense Advanced Research Projects Agency, NIST, and the National Science Foundation jointly sponsored a Workshop on Research Issues in Smart Environments. Held at the Georgia Institute of Technology in Atlanta, the workshop identified and explored multidisciplinary research issues affecting smart environments, including human-computer interaction, distributed systems infrastructure (both networking and middleware), communicating smart devices, operating systems, information management, and distributed databases.

Organizers held the workshop in a prototype smart environment, the Classroom 2000 at Georgia Tech. Workshop activities, including presentations, brainstorming sessions, and discussions, were captured using intelligent electronic whiteboards and audio and video recording devices. The resulting multimedia repository can be accessed intelligently and was used to automatically generate web pages accessible in real time to workshop participants.

The workshop supports a new NIST initiative in pervasive computing. As part of this effort, NIST is exploring smart spaces and communication among distributed devices and services, along with the measurement and standards needs of industry in this emerging area.

CONTACT: Vince Stanford, (301) 975-5399; vincent.stanford@nist.gov or Kevin Mills, (301) 975-3643; kevin.mills@nist.gov or Marty Herman, (301) 975-4495; martin.herman@nist.gov.

NIST WORKS TO IMPROVE THE INTEROPERABILITY OF ELECTRONIC DOCUMENTS

NIST is working with representatives of the Department of Justice and the federal chief information officer (CIO) Council Interoperability Group to sponsor a symposium at NIST in March 2000. The goal of the symposium is to improve the interoperability of electronic documents in the period 2000-2010, through appropriate national consensus standards that also would meet the needs of federal agencies. The industry-government symposium would begin the process toward national and federal government consensus interoperability standards for electronic documents that contain hyperlinks, multimedia (images, audio, video), applets, embedded active spreadsheets, embedded active database references, or any other features that make the documents "Compound," "Structured," or "Virtual." The symposium also will seek to reach consensus in prioritizing the electronic document standards-making work needed in 2000-2005 and to identify the voluntary consensus standards bodies that will address the standards-making work to be done.

CONTACT: Bruce Rosen, (301) 975-3299; bruce.rosen@nist.gov.

NIST AND U.S. ARMY ATC SIGN INTERAGENCY AGREEMENT

NIST has signed an interagency agreement with the U.S. Army Aberdeen Test Center (ATC) to enable cooperative large scale fire studies. ATC has "test ranges" where large fire experiments can be conducted and an industrial infrastructure to support "real-scale" fire experiments. NIST provides field measurement capabilities for temperature, heat flux, optical density of smoke, smoke analysis, heat release rate, in situ video, and infrared imaging.

The first series of cooperative experiments was conducted in July and August of 1999. An Amtrak passenger train car was installed at the ATC test site. NIST researchers developed and performed fire experiments to examine the speed of fire spread within the car and made measurements needed to validate the use of computer fire models developed at NIST for use in the fire hazard assessment for passenger cars.

CONTACT: Dan Madrzykowski, (301) 975-6677; daniel.madrzykowski@nist.gov.

NIST TBT AGREEMENT ACTIVITIES REPORT PUBLISHED

TBT Agreement Activities of the National Institute of Standards and Technology 1998 (NISTIR 6363) describes the role of NIST's National Center for Standards and Certification Information (NCSCI) in support of the World Trade Organization (WTO) Agreement on Technical Barriers to Trade (TBT). Under the U.S. Trade Agreements Act of 1979 and its amendments, NCSCI is responsible for operating the U.S. WTO TBT inquiry point for information on standards, technical regulations, and conformity assessment procedures that might significantly affect trade. The WTO Secretariat in Geneva issues notifications of proposed foreign technical regulations, and the center staff disseminates these to interested organizations, companies, and government agencies for review and comment. Center staff also coordinate comments on the proposed regulations, arrange for translations of foreign technical regulations and standards, and maintain the WTO hotline—(301) 975-4041—that provides the latest information on proposed foreign government technical regulations.

Copies of the annual report are available from NCSCI, Building 820, Room 164, (301) 975-4040; ncsci@nist.gov.

CONTACT: JoAnne Overman, (301) 975-4037; joanne.overman@nist.gov.

Standard Reference Materials

OPTICAL FIBER COATING DIAMETER SRM AVAILABLE

A new Standard Reference Material (SRM) for certification of the diameter of the primary coating on single-mode optical fiber is now available.

Single-mode optical fiber consists of a glass core surrounded by a 125 μm diameter glass cladding, which is protected from abrasion by a polymer coating (245 μm nominal diameter) applied during the fiber drawing process. A color coded layer is added to this primary coating, which brings the final fiber diameter to 250 μm. The SRM will be used to calibrate the diameter of the primary polymer coating. However, possible degradation with time of a polymer coating prompted the use of a solid glass rod (approximately 100 mm long and 250 μm in diameter) as the coating diameter artifact. The rods diameter is certified using a contact micrometer with a nominal expanded uncertainty of 0.3 μm. Common coating diameter measurements require a knowledge of the coatings refractive index, and so the SRM rods index is specified to 0.0015 and available at three values—1.504 (SRM 2553), 1.515 (SRM 2554), and 1.535 (SRM 2555)—chosen to match index values of common fiber coatings.

Accurate knowledge of a fiber's primary coating diameter enables better downstream cable processing (especially in adding the color layer) and more uniform center to center spacing for fiber ribbons. This work was done in response to a need identified by the Telecommunications Industry Association.

CONTACT: Paul Williams, (303) 497-3805; pwilliam@boulder.nist.gov.

STANDARD AIDS MODE-FIELD DIAMETER MEASUREMENT OF FIBERS

Optical fiber manufacturers and many others will want to get Standard Reference Material (SRM) 2513, NIST's new artifact for calibrating systems that use the direct far-field scanning method for measuring the mode-field diameter of a singile-mode optical fiber at wavelengths of 1.31 μm and 1.55 μm.

The SRM is a short length of uncoated fiber in an aluminum housing, with the end of the fiber carefully cleaved so that scattering will be minimal. Each unit was measured individually and bears a serial number. The certified mode-field diameters at the two wavelengths were determined by the direct far-field method as specified by the Telecommunications Industry Association. The uncertainty at each wavelength is 0.030 μm. The SRM also includes a 3.5 inch floppy disk containing raw data for the measured power as a function of angle These data may be useful for calculating the effective area of the fiber core as well.

To order SRM 2513, Mode-Field Diameter of Single-Mode Fiber, contact the Standard Reference Materials Program, NIST, 100 Bureau Drive, Stop 2322, Gaithersburg, MD 20899-2322; (301) 975-6776, fax: (301) 948-3730; srminfo@nist.gov. Information on other optoelectronic SRMs is available on the World Wide Web at ts.nist.gov/srm by choosing the "catalog" selection and searching on "optoelectronics." For technical information on SRM 2513, contact Timothy J. Drapela, NIST, MC 815.02, Boulder, CO 80303-3337; (303) 497-5858; drapela@boulder.nist.gov.

Media Contact: Fred McGehan, (303) 497-3246; mcgehan@boulder.nist.gov.

Standard Reference Data

NEW NIST DATABASE MAKES AIR QUALITY CHECKS A BREEZE

A new database now available from NIST will help measure airborne pollutants from manufacturing plants or other sources with greater accuracy. The new NIST Quantitative Infrared Database has been designed to calibrate and verify measurements made with infrared-based analytical instruments in field monitoring of hazardous air pollutants identified by the U.S. Environmental Protection Agency (EPA). The new database, available on CD-ROM, also is the first issued by NIST that can be used to establish traceability to NIST's primary gas standards. A team of NIST scientists created the database in response to a request from the EPA.

NIST scientists accurately measured and assessed the uncertainty of the infrared spectra for 21 volatile organic compounds identified as high priorities by the EPA. The measurements were made on primary gas standards prepared and verified at NIST. In the future, researchers will expand and update the database to contain about 100 of the 189 compounds listed in the Clean Air Act amendments.

The database includes programs to allow viewing, printing and verifying the spectra. The database also employs data authentication to assure users that spectral files are unaltered and traceable to NIST.

The Quantitative Infrared Database, NIST Standard Reference Database 79, is available from the NIST Standard Reference Data Program for $240. It runs on a Windows 95, Windows 98 or Windows NT operating system. Updates will be available over the Internet. For more information on the database, go to www.gases.nist.gov on the World Wide Web. To order, contact the NIST SRDP, 100 Bureau Drive, Stop 2310, Gaithersburg, MD 20899-2310; (301) 975-2208; fax: (301) 926-0416; srdata@nist.gov.

Media Contact: Linda Joy, (301) 975-4403; linda.joy @nist.gov.

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Calendar

December 6–8, 1999

NEW CHALLENGES FOR MEASUREMENT AND STANDARDS IN A DEREGULATED ELECTRIC POWER INDUSTRYY

Location: Key Bridge Marriott
Arlington, VA

Sponsors: National Institute of Standards and Technology (NIST), EPRI Power Quality Product Line, IEEE Power Engineering Society, National Science Foundation, National Electrical Manufacturers Association Power Equipment Division, and the U.S. Department of Energy.
Audience: Technical people from all institutions with interest in the electric power industry, including electric utilities, electrical equipment manufacturers, and electricity regulatory bodies.
Format: Workshop with plenary speakers and panel sessions.
Purpose: To address the technical problems related to measurements and standards that need to be considered in order to ensure continued reliable generation, transmission, and distribution of electric power.
Topics: Competitive metering, bulk power measurements, distributed generation, communication and control technologies, power quality, advanced diagnostics, voluntary and standards.
Technical Contact: James K. Olthoff, NIST, 100 Bureau Dr., Stop 8113, Gaithersburg, MD 20899-8113, phone: 301/975-2431, fax: 301/948-5796, email: james.olthoff@nist.gov.
Website: http://wwweeel.nist.gov/deregulation-workshop.
Electronic Registration:
http://sales.nist.gov/conf/secure/CONF147/CONF147/conf_register.htm

March 14–16, 2000

13TH ANNUAL FEDERAL INFORMATION SYSTEMS SECURITY EDUCATOR'S ASSOCIATION (FISSEA) CONFERENCE

Location: Hilton Hotel
Gaithersburg, MD

Sponsors: National Institute of Standards and Technology (NIST) and Federal Information System Security Educator's Association (FISSEA).
Audience: Information systems security professionals, trainers, educators, and managers who are responsible for information systems security training in federal agencies. Contractors of these agencies and faculty members of accredited educational institutions are also welcome.
Format: Conference.
Purpose: Theme – "Effective IT Security Training Strategies."
Topics: "Strategies for Getting Started – What Works!", "Strategies for Keeping Your Program Informative and Fun!", "Strategies for the Future".
Technical Contact: Patricia Black, U.S. Department of Treasury, 1500 Pennsylvania Ave., NW, Room 3090 ANX, Washington, DC 20220, phone: 202/622-2056, email: patricia.black@cio.treas.gov and Lisa Biafore, Integrated Management Services, Inc., phone: 304/296-0107, email: lbiafore@imsidc.com and Peggy Himes, NIST, 100 Bureau Drive, Stop 8970, Gaithersburg, MD 20899-8970, phone: 301/975-2489, email: peggyhimes@nist.gov.
Website: http://csrc.nist.gov/organizations/fissea.html.

June 19–22, 2000
DISLOCATIONS 2000

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: National Institute of Standards and Technology (NIST), Center for Theoretical and Computational Materials Science/Metallurgy Division and Pacific Northwest National Laboratory.
Audience: Researchers from industry, government laboratories, and universities who are interested in the fundamental mechanisms of plastic deformation.
Format: This will be an international conference with plenary speakers, invited speakers, and poster sessions. The invited speakers win be selected from the submitted abstracts.
Purpose: To facilitate international cooperation in the field and to identify useful directions for future research.
Topics: Fundamental research on dislocations in all types of materials and their role in plasticity.
Technical Contact: Lyle Levine, NIST, 100 Bureau Drive, Stop 8553, Gaithersburg, MD 20899-8553, phone: 301/975-6032, fax: 301/975-4553, email: lylelevine@nist.gov
Website: http://www.metallurgy.nist.gov/D20OO/D200O.html.

June 25-30, 2000
FOURTEENTH SYMPOSIUM ON THERMOPHYSICAL PROPERTIES

Location: University of Colorado Boulder, CO

Sponsors: National Institute of Standards and Technology (NIST) and the American Society of Mechanical Engineers.
Format: Symposium.
Purpose: This is the Fourteenth Symposium of the well-established series of conferences on thermophysical properties. The Symposium is concerned with theoretical experimental, and applied aspects of the thermophysical properties of gases, liquids, and solids.
Topics: Thermodynamic Properties, including equation of state, phase equilibria, *p-v-T* behavior, heat capacity, enthalpy, thermal expansion, sound speed velocity, and critical phenomena. Transport Properties, including thermal and electrical conductivity, viscosity, mass diffusion, thermal diffusion, and non-Newtonian behavior. Optical and Thermal Radiative Properties, including dielectric constant, refractive index, emissivity, reflectivity, and absorptivity. Interfacial Properties, including solid-solid interfaces, surface tension, interfacial profiles, interfacial transport, and wetting. Data Correlation, including data evaluation and prediction, standard reference data, databases, and storage and retrieval of thermophysical-propertv data. Special topics included in the symposium are: properties of complex fluids (e.g., ionic fluids, micellar and polymer solutions) properties of alternative refrigerants, data for energy and environmental engineering, properties for process design, properties of supercritical fluids, properties of new materials (composites, films, polymers), properties of molten materials, shear effects on thermophysical properties, advanced optical and acoustic techniques, computer simulations, subsecond thermophysics and database demonstrations.
Technical Contact: W. M. (Mickey) Haynes, Physical and Chemical Properties Division, 838 National Institute of Standards and Technology, NIST, 325 Broadway, Boulder, CO 80303, phone: 303/497-3247, fax: 303/497-5044,
email: willam.haynes@nist.gov.
Website: http://www.symp14.nist.gov.

September 25–29, 2000
SYMPOSIUM ON OPTICAL FIBER MEASUREMENTS

Location: National Institute of Standards and Technology Boulder, CO

Sponsors: National Institute of Standards and Technology (NIST), IEEE Lasers and Electro Optics Society and the Optical Society of America.
Audience: Private companies, government labs, and universities engaged in light-wave communication.
Format: Contributed and invited papers grouped into session.
Purpose: To provide a forum for reporting the results of recent measurement research in the area of lightwave communications including optical fibers.
Topics: Optical fiber metrology including attenuation, dispersion, geometry, reflectometry, and connectors; integrated optic devices; laser diode sources and detectors; system measurements.
Technical Contact: Paul Williams, NIST, 325 Broadway, Mailcode 815.02, Boulder, CO 80303-3328, phone: 303/497-3805, fax: 303/497-3387, email: paul.williams@boulder.nist.
Website: http://www.boulder.nist.gov/div815/current.htm.

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The 1994 edition of the National Institute of Standards and Technology Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, by Barry N. Taylor and Chris E. Kuyatt is now available.

The 1994 edition of TN 1297 includes a new appendix—Appendix D—which clarifies and gives additional guidance on a number of topics related to measurement uncertainty, including the use of certain terms such as accuracy and precision. Very minor word changes have also been made in a few portions of the text of the 1993 edition in order to recognize the official publication in October 1993 by the International Organization for Standardization (ISO) of the *Guide to the Expression of Uncertainty in Measurement* on which TN 1297 is based. However, the NIST policy on measurement uncertainty, Statements of Uncertainty Associated with Measurement Results, which is reproduced as Appendix C of TN 1297, is unchanged.

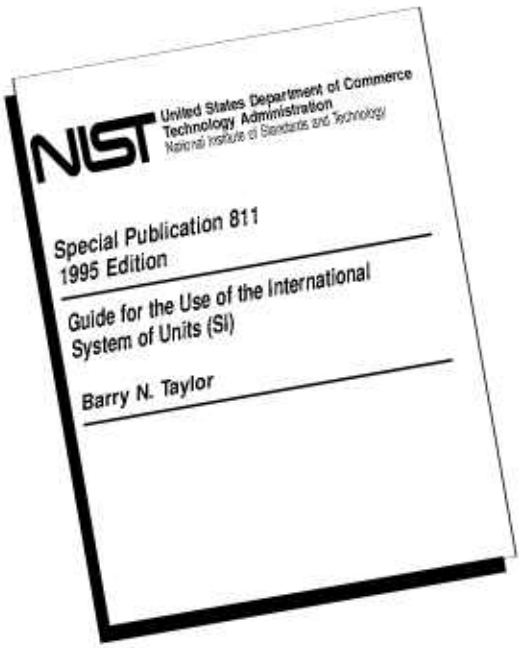
It is expected that the 1994 edition of TN 1297 will be even more useful than its immediate predecessor, the 1993 edition, of which 10 000 copies were distributed worldwide.

Those United States readers who wish to delve into the subject of measurement uncertainty in greater depth may purchase a copy of the 100-page ISO *Guide* from the Sales Department of the American National Standards Institute (ANSI), 105-111 South State Street, Hackensack, NJ 07601. Copies may also be purchased from the ISO Central Secretariat, 1 rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

Single copies of the 20-page TN 1297 may be obtained from the NIST Calibration Program, 100 Bureau Dr., Building 820, Room 236, Stop 2330, Gaithersburg, MD 20899-2330, telephone: 301-975-2002, fax: 301-869-3548.

The International System of Units (SI)

The Modern Metric System



Uncertain about the International System of Units (universally abbreviated SI), the modern metric system used throughout the world? Do you need to know the proper way to express the results of measurements and the values of quantities in units of the SI? Do you need to know the NIST policy on the use of the SI? Then you need the 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*.

The 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*, by Barry N. Taylor, is now available.

The 1995 edition of SP 811 corrects a number of misprints in the 1991 edition, incorporates a significant amount of additional material intended to answer frequently asked questions concerning the SI and SI usage, and updates the bibliography. The added material includes a check list for reviewing the consistency of written documents with the SI. Some changes in format have also been made in an attempt to improve the ease of use of SP 811.

The topics covered by SP 811 include:

- NIST policy on the use of the SI in NIST publications.
- Classes of SI units, those SI derived units that have special names and symbols, and the SI prefixes that are used to form decimal multiples and submultiples of SI units.
- Those units outside the SI that may be used with the SI and those that may not.
- Rules and style conventions for printing and using quantity symbols, unit symbols, and prefix symbols, and for spelling unit names.
- Rules and style conventions for expressing the results of measurements and the values of quantities.
- Definitions of the SI base units.
- Conversion factors for converting values of quantities expressed in units that are mainly unacceptable for use with the SI to values expressed mainly in units of the SI.
- Rounding numbers and rounding converted numerical values of quantities.

Single copies of the 84-page SP 811 may be obtained from the NIST Calibration Program, 100 Bureau Dr., Building 820, Room 236, Stop 2330, Gaithersburg, MD 20899-2330, telephone: 301-975-2002, fax: 301-869-3548.

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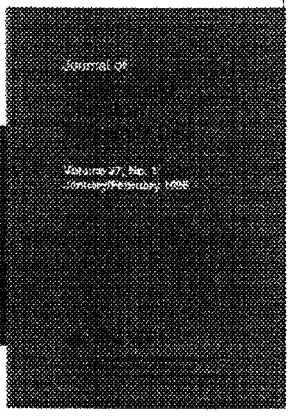

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by Marilyn E. Jacox, Optical Technology Division, National Institute of Standards and Technology, Gaithersburg, MD, U.S.A. *(March/April 1998)*

The Viscosity of Carbon Dioxide
by A. Fenghour (Department of Chemical Engineering and Chemical Technology, Imperial College, London, U.K.), W. A. Wakeham (Department of Chemical Engineering and Chemical Technology, Imperial College, London, U.K.), and V. Vesovic (Department of Earth Resources Engineering, Imperial College, London, U.K.) *(January/February 1998)*

An International Standard Equation of State for Difluoromethane (R-32) for Temperatures from the Triple Point at 136.34 K to 435 K and Pressures up to 70 MPa
by Reiner Tillner-Roth (Institut für Thermodynamik, Universität Hannover, Hannover, Germany) and Akimichi Yokozeki (DuPont Chemicals, Fluorochemicals Laboratory, Wilmington, Delaware, U.S.A.) *(November/December 1997)*

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